BLACK BOX NETWORK SERVICES

LBH21xA-H-SFP
LBH21xAE-H-SFP
LBH212A-HD-SFP
LBH21xA-P-SFP
LBH21xAE-P-SFP
LBH212A-PD-SFP

Universal Media Converter Switch

Provides full 1000-/100-/10-Mbps switching services for high performance Ethernet LANs.

Includes two SFP open transceiver fiber switch ports and one 10-/100-/1000-Mbps copper switch port.

Customer Support Information

Order toll-free in the U.S.: Call 877-877-BBOX (outside U.S. call 724-746-5500) FREE technical support 24 hours a day, 7 days a week: Call 724-746-5500 or fax 724-746-0746 Mailing address: Black Box Corporation, 1000 Park Drive, Lawrence, PA 15055-1018
Web site: www.blackbox.com • E-mail: info@blackbox.com

Federal Communications Commission and Industry Canada Radio Frequency Interference Statements

This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio communication. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart B of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case the user at his own expense will be required to take whatever measures may be necessary to correct the interference.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This digital apparatus does not exceed the Class A limits for radio noise emission from digital apparatus set out in the Radio Interference Regulation of Industry Canada.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique publié par Industrie Canada.

Instrucciones de Seguridad
(Normas Oficiales Mexicanas Electrical Safety Statement)

1. Todas las instrucciones de seguridad y operación deberán ser leídas antes de que el aparato eléctrico sea operado.
2. Las instrucciones de seguridad y operación deberán ser guardadas para referencia futura.
3. Todas las advertencias en el aparato eléctrico y en sus instrucciones de operación deben ser respetadas.
4. Todas las instrucciones de operación y uso deben ser seguidas.
5. El aparato eléctrico no deberá ser usado cerca del agua—por ejemplo, cerca de la tina de baño, lavabo, sótano mojado o cerca de una alberca, etc..
6. El aparato eléctrico debe ser usado únicamente con carritos o pedestales que sean recomendados por el fabricante.
7. El aparato eléctrico debe ser montado a la pared o al techo sólo como sea recomendado por el fabricante.
8. Servicio—El usuario no debe intentar dar servicio al equipo eléctrico más allá a lo descrito en las instrucciones de operación. Todo otro servicio deberá ser referido a personal de servicio calificado.
9. El aparato eléctrico debe ser situado de tal manera que su posición no interfiera su uso. La colocación del aparato electric sobre una cama, sofá, alfombra o superficie similar puede bloquea la ventilación, no se debe colocar en libreros o gabinetes que impidan el flujo de aire por los orificios de ventilación.
10. El equipo eléctrico deber ser situado fuera del alcance de fuentes de calor como radiadores, registros de calor, estufas u otros aparatos (incluyendo amplificadores) que producen calor.
11. El aparato eléctrico deberá ser connectado a una fuente de poder sólo del tipo descrito en el instructivo de operación, o como se indique en el aparato.

12. Precaución debe ser tomada de tal manera que la tierra fisica y la polarización del equipo no sea eliminada.
13. Los cables de la fuente de poder deben ser guiados de tal manera que no sean pisados ni pellizcados por objetos colocados sobre o contra ellos, poniendo particular atención a los contactos y receptáculos donde salen del aparato.
14. El equipo eléctrico debe ser limpiado únicamente de acuerdo a las recomendaciones del fabricante.
15. En caso de existir, una antena externa deberá ser localizada lejos de las lineas de energia.
16. El cable de corriente deberá ser desconectado del cuando el equipo no sea usado por un largo periodo de tiempo.
17. Cuidado debe ser tomado de tal manera que objectos liquidos no sean derramados sobre la cubierta u orificios de ventilación.
18. Servicio por personal calificado deberá ser provisto cuando:
    - A: El cable de poder o el contacto ha sido dañado; u
    - B: Objectos han caído o líquido ha sido derramado dentro del aparato; o
    - C: El aparato ha sido expuesto a la lluvia; o
    - D: El aparato parece no operar normalmente o muestra un cambio en su desempeño; o
    - E: El aparato ha sido tirado o su cubierta ha sido dañada.

Trademarks Used in this Manual

Black Box and the Double Diamond logo are registered trademarks of BB Technologies, Inc.

Ethernet is a trademark of Xerox Corporation

NEBS is a trademark of Telcordia Technologies

UL is a registered trademark of Underwriters Laboratories

Any other trademarks mentioned in this manual are acknowledged to be the property of the trademark owners.

Table of Contents

1. SPECIFICATIONS

1.1 Technical Specifications

Ports Performance
Data Rate: 10-/100-/1000-Mbps

Network Standards
1000Mb: Ethernet IEEE 802.3ab and 802.3z
1000BASE-T, -SX, -LX and -ZX
100Mb: Ethernet IEEE 802.3u, 100BASE-TX, 100BASE-FX
10 Mb: Ethernet IEEE 802.3, 10BASE-T
Auto-sensing for speed: IEEE 802.3z

Packet-Processing Between Domains
Filter and Forward Rate from 1000-Mbps ports:
1,488,000 pps max.
Filter and Forward Rate from 100-Mbps ports:
148,800 pps max.
Filtering and Forwarding Rate from 10-Mbps ports:
14,880 pps max.
Processing type: Store and Forward, non-blocking
Auto-learning: 1K-address table
Address buffer age-out time: 300 sec.
Packet buffers memory: 64KB, dynamically shared on all domains
Latency (not including packet time):
1000 to 1000 Mbps: <3µs
100 to 100 Mbps: <5µs
10 to 10 Mbps: <18µs
100 to 10 Mbps: <5µs
10 to 100 Mbps: <15µs

Path Delay Value: 50 BT on all ports

Maximum Ethernet Segment (or Domain) Lengths

10BASE-T (Unshielded twisted pair)	100 m (328 ft)
100BASE-TX (CAT 5 UTP)	100 m (328 ft)
100BASE-FX, half-duplex: (multi-mode)	412 m (1350 ft)
100BASE-FX, full duplex: (multi-mode)	2 km (6562 ft)
100BASE-FX, half-duplex: (single-mode)	412 m (1350 ft)
100BASE-FX, full duplex: (single-mode)	20 km (65,620 ft)
100BASE-FX, full duplex: (single-mode, long reach)	40 km (131,240 ft)
1000BASE-T (CAT5E OR CAT6 recommended)	100 m (328 ft)
1000BASE-SX, full duplex, multi-mode (62.5um)	220 m (722 ft)
1000BASE-SX, full duplex, multi-mode (50um)	550 m (1804 ft)
1000BASE-LX, full duplex, single-mode (9um)	5 km (16404 ft)
1000BASE-ZX, full duplex, single-mode (9um)	>70 km (229,659 ft)

Operating Environment

LBH21xA-H: (Hardened)

-13°F to 140°F (-25°C to 60°C) Long term per agency tests (UL)

-40°F to 185°F (-40°C to 85°C) Short term per IEC Type tests

LBH21xA-P: (Extreme)

-40°F to 167°F (-40°C to 75°C) Long term per agency tests (UL)

-40°F to 185°F (-40°C to 85°C) Short term per IEC Type tests

Storage Temperature,

All models: -40°F to 212°F (-40°C to 100°C)

Cold Start:

LBH21xA-H to -20ºC
LBH21xA-P to -40ºC

Ambient Relative Humidity: 5% to 95% (non-condensing)

Altitude: -200 to 50,000ft. (-60 to 15,000 m)

Conformal Coating (optional) for humidity protection

Note: LBH21-Series are designed for NEBS compliance, including, vibration, shock and altitude.

Packaging:

Enclosure: Rugged sheet metal (Aluminum)

Dimensions of the Switch unit:

3.5"H x 3.0"W x 1.0"D (8.9 x 7.6 x 2.5 cm)

Weight: LBH21-Series: 6.1 oz. (173g)

Power supply: LBH210A & AE-H: 5.8 oz (165g)

LBH210A & AE-P: 7.9 oz (225g)

Cooling Method:

Convection on the LBH21-Series models. The Hardened (H) factory floor and Extreme (P) temperature uncontrolled location models have closed cases to withstand dirt and use special thermal techniques to transfer heat to the outside of the case for cooling.

POWER SUPPLY

AC POWER SUPPLY (using an external power adapter):

All models have a (8-15) VDC output with 6-ft. (1.8-m) long cord and a 2.5-mm center +ve jack. The power supplies are temperature rated to match the Converter Switch ratings.

Factory Floor (H) Ratings (-25 to 60°C)

North America (LBH210A-H) models.
Hardened, factory floor temperature rated.
Input: 6ft AC power cord to IEC 320 connector on the 100-240 VAC 47-63 Hz external power adapter.
Output: 12-VDC, 1.25Amps

International (LBH210AE-H) models. Factory floor temperature rated.
Input: IEC 320 connector on the 100-240vac 47-63Hz external power adapter. Requires a user supplied power cord
Output: 12-VDC, 1.25 Amps

Temperature uncontrolled Extreme (P) Ratings (-40 to 75°C)

North America (LBH210A-P) models. Outdoor temperature rated.
Input: 6-ft. (1.8-m) AC power cord to IEC 320 connector on the 100-240 VAC, 47-63-Hz external power adapters.
Output: 12-VDC, 2Amps.

International (LBH210AE-P) models. Outdoor temperature rated. Input: IEC 320 connector on the 100-240-VAC, 47-63-Hz external power adapter. Requires a user supplied power cord.
Output: 12-VDC, 2 Amps.

Direct DC POWER SUPPLY: built-in terminal block for

+, -, ground along with 12-VDC jack

12V DC internal (range of 8.0 to 15V DC)

24V DC internal (range of 18 to 36V DC).

-48V DC internal (range of 36 to 60V DC), -, ground

Power Consumption: See Section 3.6.

Note 1: the 8-15V DC jack can be used for dual source DC input using an AC adapter and the DC terminal block. Power supply protection is provided by internal diodes.
Note 2: The Direct DC power floats. The user may ground either "+" or "-" if desired.

Port Connectors:

One RJ-45 Port: supports 10/100/1000Mbps with auto cross (MDIX). It is shielded 8-pin female connector for shielded (STP) and unshielded (UTP) CAT 3, 4, 5 cables.

Two Fiber optic ports:

The LBH21-Series is 100BASE-FX or 1000BASE-SX /-LX / -ZX with a optional choice of multimode or singlemode SFP connectors.

Switches:

Each SFP port is factory set to Gb speed.

User may select 100Mb speed via DIP switch on the back of the unit.(see below)

Each SFP port is individually speed-selectable.

NOTE: After changing the speed switch setting, power cycle the unit for the speed setting to take effect.

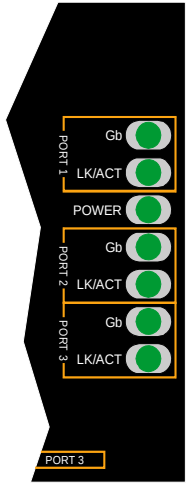
LED Indicators (Two sets) top-front and end with ports

Top-Front: (shown)

POWER: Steady ON when power applied

Gb per port: Steady ON for 1000 Mbps;
OFF for 100 Mbps or 10 Mb speed

LK/ACT per port: Steady ON for LINK (LK) with no traffic,
BLINKING for Activity



End with Ports:

POWER: Steady ON when power applied

10/100/Gb per RJ-45 port: Steady ON for 100Mb,
OFF for 10Mb,
BLINKING for Gb

Fiber port: LK/ACT: Steady ON for Link with no traffic,
BLINKING for Activity

Mounting options :

Metal mounting clips for panel mounting: included
DIN-Rail mounting option: (see Section 3.4)
Rack-mount option: LE1505-RACK

Mean Time Between Failure (MTBF):

over 15 years, Telcordia (Bellcore) Method

Agency Approvals and Standards Compliance:

UL Listed (UL 60950), cUL, CE, Emissions FCC Part 15 Class A
NEBS L3 and ETSI compliant.
P model: IEEE P1613 Env. Std for Electric Power Substations
P model: NEMA TS-2 and TEES for traffic control equipment
P model: designed for UL 2043 above-the-ceiling installation
IEC61850 EMC and Operating Conditions Class C Power Substations

Warranty: Three years, return to factory Made in USA

1.2 Summary of models and descriptions:

(Hardened Model) for 1000Mb fiber

LBH210A-H-SFP =
LBH210AE-H-SFP* = Hardened (H), one 10/100/1000Mb RJ-45+ two 1000Mb Fiber ports for factory floor (-25 to 60C) using a direct DC (8-15VDC) and/or external AC hardened power supply (included).

LBH211A-H-SFP = Same as LBH210A model, except AC hardened power supply is not included

LBH212A-H-SFP = Same as LBH211A model, except 24VDC power input replaces 12VDC.

LBH212A-HD-SFP = Same as LBH212A model, but includes DIN-Rail clip mounting option.

LBH214A-H-SFP = Same as LBH212A model, except -48VDC power input replaces 24VDC

(Extreme Model) for 1000Mb fiber

LBH210A-P-SFP =
LBH210AE-P-SFP* = Extreme (P), one 10/100/1000Mb RJ-45+ two 1000Mb Fiber ports for uncontrolled (outdoor) (-40 to 75C) using direct DC (8-15VDC) and/or external AC premium power supply (included).

LBH211A-P-SFP = Same as LBH210A model, except AC Premium power supply is not included

LBH212A-P-SFP = Same as LBH211A model, except 24VDC power input replaces 12VDC.

LBH212A-PD-SFP = Same as LBH212A model, but includes DIN-Rail clip mounting option.

LBH214A-P-SFP = Same as LBH212A model, except -48VDC input replaces 24VDC

*AE models = (does not include a AC power cord)

Fiber Port Connectors:

Optional SFP Fiber transceivers for open SFP slots

LFP220P = 1000BASE-SX-LC: 850nm multi-mode SFP, 550 m
LFP221P = 1000BASE-SX Extended: 1310nm multi-mode fiber optic with LC type connector, 2 km
LFP222P = 1000BASE-LX-SLC: 1310nm single-mode SFP, 10 km
LFP223P = 1000BASE-LX-SLC: 1310nm single-mode SFP, 25 km
LFP224P = 1000BASE-ZX-SLC: 1550nm single-mode SFP, 40 km
LFP225P = 1000BASE-ZX-SLC: 1550nm single-mode SFP, 70 km

LFP120P = 100BASE-FX, multi-mode SFP, 2 km
LFP121P = 100BASE-FX, single-mode SFP, 15 km
LFP122P = 100BASE-FX, single-mode SFP, 40 km

Accessories

LE1505-RACK = 19" Rack-mount tray for LBH21-series Switch models, up to 16 units
Other Tray configurations with power supplies and power cabling included – See Section 3.3

DIN-RAIL MC2 = Metal DIN-Rail mounting bracket for one LBH21-Series Switch, See Section 3.4

Conformal Coating:
(for high humidity and "tropical" applications) - request quote

2. INTRODUCTION

This section describes LBH21-Series models, including appearance, features and typical applications.

2.1 Inspecting the Package and the Product

Examine the shipping container for obvious damage prior to installing this product; notify the carrier immediately of any damage that you believe occurred during shipment or delivery. Inspect the contents of this package for any signs of damage and ensure that the items listed below are included.

This package should contain:

1	LBH21-Series Converter Switch unit,
1	External Power Supply, (for LBH210A & AE models only)
1 set	Metal panel mounting clips and screws (2 each)
1	User Guide (this manual)

Remove the Converter Switch from the shipping container. Be sure to keep the shipping container in case you need to ship the unit at a later date.

If items are missing or damaged, contact Black Box Technical Support at 724-746-5500 or info@blackbox.com. If you need to return the unit, use the original shipping container. Refer to Chapter 5, Troubleshooting, for specific return procedures.

2.2 Product Description

2.2.1 LBH21-Series Product Description

The latest technology of SFP fiber transceivers has been integrated into the LBH21-Series Universal Converter Switch package. It can handle any Gb fiber type – multi-mode and single-mode – and fiber media distance with a selection of Gb SFP fiber transceivers, up to two of which can be plugged in. It can also handle any 100Mb fiber media type and distance in the same way, with a selection of 100Mb SFP fiber transceivers that similarly plug in. And, for copper media attachment, there is a 10/100/1000 auto-negotiating RJ-45 port. Where Gb Ethernet is in use, the LBH21-Series converts all media combinations.

The LBH21-Series Converter Switches have two 1000Mb or 100Mb Fiber ports available to cover the full range of application environments, with Hardened (factory floor), and Extreme-rated (outdoor) versions. Extra features for heavy-duty and extended temperature operation ranges are included selectively in the Hardened factory-floor and Extreme-rated outdoor models. This selection of models and fiber port types offers the best price-to-value ratio for each user and installation. Where a Media Converter might have been used, a Converter Switch offers a better value. The compact package is ideal for network edge installations, and is able to be conveniently mounted to suit any application.

The LBH21xA-H Hardened units are for the office and factory floor applications. The hardened (-H) models are built with high-grade components and are constructed using special thermal techniques and a metal case for heavy-duty industrial jobs. In addition to a Hardened AC power option and jack, terminals for internal DC power choices at 8 to 15V, 24V or -48V DC are included. The ambient temperature rating of -25 to 60C is for industrial use.

No internal airflow is required for cooling, so it resists dust, dirt, moisture, smoke and insects. Mounting options include stand-alone panel mounting, DIN-Rail, or rack-mount tray.

The LBH21xA-P Extreme-rated units are for temperature uncontrolled applications (-40 to 75° C), typically located outdoors. The Extreme (-P) models are built with premium-grade extended temperature components, and use similar thermal techniques as the Hardened units. In addition to a Premium-rated AC power option and jack, terminals for internal DC power choices at 8 to15V, 24V or -48V DC are included. When used outdoors, the LBH Extreme units should be protected from falling rain. Mounting options include stand-alone panel mounting, DIN-rail, or rack-mount tray.

The LBH21-Series provides switching between one 10/100/1000 auto-negotiating copper port and two 100 or 1000Mb fiber ports which are SFP multi-mode or single-mode. The plug-and-play, energy-efficient, and flavor rich fiber features make this sleek multi-purpose Switch convenient and cost-effective for the user. The selection of various temperature ranges enables deployment in various industrial environments. And, it uses very little space. Providing the combination of Media Converter with Switch, the LBH21-Series switch is an ideal choice for edge-of-the-network applications.

Fig 2.2.1a
LBH210A-H with two SFP slots

The “Hardened” labeled LBH21-Series units (as shown in Fig 2.2.1a) are designed for office and wiring closet environments and factory floor/Industrial applications. Using special thermal techniques and a sealed rugged metal case for heavy-duty industrial applications no air inflow is required for cooling, so the LBH21-Series resist dust, dirt, moisture, smoke and insects. Choices of models for external AC or internal DC power are available. Ambient operating temperature is -25°C to + 60°C depending on the power source used. Storage temperature rating is -40°C to + 100°C.

Fig 2.2.1b
LBH210A-P with two SFP slots

The “Extreme” labeled LBH21-Series (as shown in Fig. 2.2.1b) are premium rated units suitable for temperature uncontrolled outdoor applications. Specially designed with premium-grade extended temperature components, the LBH21xA-P units use similar thermal techniques to the LBH21xA-H hardened units for cooling. Mounting options include panel mounting, DIN-rail, or rack-mount tray. Choices of models for external AC or internal DC power are available. Ambient operating temperature is between -40°C to +75°C depending on the power source used. Storage temperature rating is between -40°C to +100°C.

The front side of the unit has one twisted-pair 10/100/1000Mb switch port and two 100 or 1000Mb fiber ports. The RJ-45 port of the LBH21-Series Converter switches support auto cross (MDI-X) operation performing the autocross function under auto-negotiation mode only. The LBH21 models are factory configured at Full Duplex.

Two sets of LEDs indicating the operating status of ports are mounted on the top and front (for extra viewing advantage while rack-mounted). For each port, there are Link and Activity (LK/ACT) LED's on the top indicating that the media cables are connected correctly and showing, by blinking, when there is traffic. The LK/ACT LED's are repeated on the front as LA1 (port 1), LA2 (port 2), and LA3 (port 3). There is a power (PWR) indicator on the front of the unit to validate that the unit is turned ON.

The two fiber ports on the LBH21-Series switch are multi-mode or single-mode with a small form-factor connector (LC multi-mode or LC single-mode).

The external DC power plug connector and/or "jack" and the internal DC input terminal is provided on the rear of the unit.

2.3 Frame Buffering and Latency

The LBH21-Series Converter Switches are store-and-forward switches. Each frame (or packet) is loaded into the Switch's memory and inspected before forwarding can occur. This technique ensures that all forwarded frames are of a valid length and have the correct CRC, i.e. they are good packets. This eliminates propagation of bad packets, enabling all of the available bandwidth to be used for valid information.

While other switching technologies such as "cut-through" or "express" impose minimal frame latency, they will also permit bad frames to propagate out to the Ethernet segments connected. The "cut-through" technique permits collision fragment frames, which are a result of late

collisions, to be forwarded to add to the network traffic. Since there is no way to filter frames with a bad CRC (the entire frame must be present in order for CRC to be calculated), the result of indiscriminate cut-through forwarding is greater traffic congestion, especially at peak activity. Since collisions and bad packets are more likely when traffic is heavy, the result of store-and-forward operation is that more bandwidth is available for good packets when the traffic load is greatest.

To minimize the possibility of dropping frames on congested ports, each LBH21-Series Converter Switch dynamically allocates buffer space from 64Kb memory pool, ensuring that heavily used ports receive very large buffer space for packet storage. (Many other switches have their packet buffer storage space divided evenly across all ports, resulting in a small, fixed number of packets to be stored per port. When the port buffer fills up, dropped packets result.) This dynamic buffer allocation provides the capability for the maximum resources of the LBH21-Series unit to be applied to all traffic loads, even when the traffic activity is unbalanced across the ports. Since the traffic on an operating network is constantly varying in packet density per port and in aggregate density, the LBH21-Series Converter Switches are constantly adapting internally to provide maximum network performance with the least dropped packets.

When the Switch detects that its free buffer queue space is low, the Switch sends industry standard (full-duplex only) PAUSE packets out to the devices sending packets to cause “flow control”. This tells the sending devices to temporarily stop sending traffic, which allows a traffic catch-up to occur without dropping packets. Then, normal packet buffering and processing resumes. This flow-control sequence occurs in a small fraction of a second and is transparent to an observer.

Another feature implemented in LBH21-Series Converter Switches is a collision-based flow-control mechanism (when operating at half-duplex only). When the Switch detects that its free buffer queue space is low, the Switch prevents more frames from entering by forcing a collision signal on all receiving half-duplex ports in order to stop incoming traffic.

The latency (the time the frame spends in the Switch before it is sent along or forwarded to its destination) of the LBH21-Series Converter Switches varies with the port-speed types. The length of the frame is a variable as it is with all store-and-forward switches. For 10 Mb-to-10 Mb or 10 Mb-to-100Mb or 100Mb-to-10 Mb forwarding, the latency is 15 microseconds plus the packet time at 10 Mb. For 100Mb-to-100Mb forwarding, the latency is 5 microseconds plus the packet time at 100Mb.

2.4 Features and Benefits

- **Full 1000Mb, 100Mb or 10 Mb switching services for high performance Ethernet LANs**

  LBH21-Series Switches provide Fast Ethernet switching on all ports. They perform high-speed filter/forward operations on the traffic, giving each port's segment a full 1000Mb, 100Mb or 10 Mb of bandwidth.

- **Reduces Network Costs and provide economical solution**

  LBH21-Series Switches offer the ideal solution to efficiently and inexpensively connect a Twisted Pair and fiber network with 10Mb, 100Mb or 1000Mb and help to expand the Ethernet network in a very convenient and economical way.

- **Choice of 10, 100 or 1000Mb Fiber option, more efficient than media converter**

  Designed as a multi-purpose media converter and Switch, the 10, 100 or 1000Mb fiber port allows the user to convert the media from copper to fiber and the other RJ-45 port can be used as diagnostic port or for more connectivity.

- **Installation is "Plug and Play", operation is transparent to software**

  The LBH21-Series Switches operate as hardware switches, only forwarding those packets from each domain that are needed on the other domains. Internal address tables are self-learning, enabling users to change port connections or 10/100/1000 domains without affecting operations.

- **Two sets of LEDs for viewing status from any angle**

  Each LBH21-Series Converter Switch is equipped with two sets (front and top) of LEDs to provide status information when viewed at almost any angle or mounting arrangement whether rack (LE1505-RACK) or wall-mounted**.**

- **Rugged metal case, Industrial grade**

  LBH21-Series have a robust design and are packaged in a rugged sheet metal enclosure to ensure high reliability and durability even when placed in industrial or outdoor applications.

- **Qualified to use for temperature uncontrolled "outdoor" application**

  The LBH21-Series Extreme rated versions of Converter Switches have an ambient temperature rating between –40C to +75C for DC models and qualify for temperature uncontrolled "outdoor" application.

- **Efficient Compact design, for all purpose convenient mounting**

  Featuring a compact aluminum case with an external AC and internal DC power supply, LBH21-Series of Converter Switches can be installed in small spaces in cabinets, on table tops, in racks, wall or DIN rail mounted and in trays such as the LE1505-RACK.

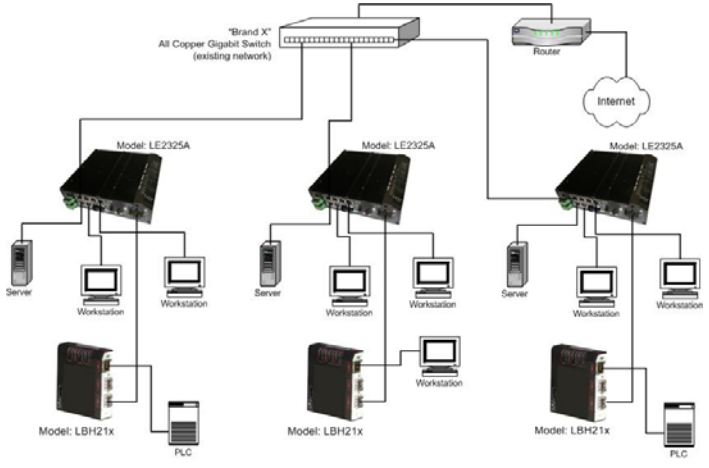
- **MDI-X ports to eliminate cross-over cable while cascading**

  All the LBH210-Series Switches are featured with MDIX (auto-cross), which easily allow cascading with other Switch Hubs or media converters, without using the crossover cable.

2.5 Applications for LBH210-Series Converter Switches

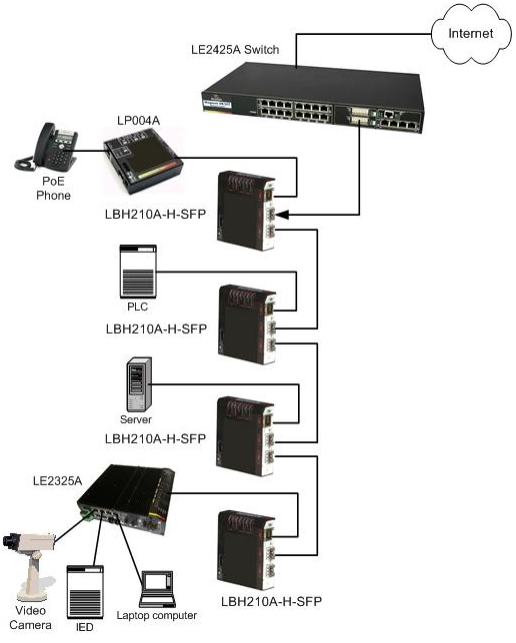
Enriched with the two tier hardness ratings (“Hardened”, and “Extreme” rated, outdoor), the multifunctional, multi-media and multi-environmental, LBH21-Series Converter Switches fit very well in almost any environment enabling users to scale their networks quickly and cost effectively. The edge-of-the-network connectivity solutions offered by Black Box Converter Switches are focused on providing easier, more economical and ultra-reliable industrial application products. The compactly designed LBH21-Series act as very useful tools in the modern life of fast expanding network requirements. The Triple-Speed and Dual-media functions support a mixed environment of 10 Mbps, 100Mbps and 1000Mbps users with copper and fiber media. The up-link choice of 10, 100 or 1000Mb fiber on Port# 1 enables easy expansion for the on-going demand of Ethernet networks. The 10-/100-/1000-Mbps auto-negotiating copper ports together with the 100- or 1000-Mbps fiber port choices and the availability the industry standard fiber connectors, enable easy interfacing with existing cable plant and equipment. The LBH21-Series fit very well in high temperature locations experiencing a need to scale the LAN quickly and cost effectively. The LBH21 provides a very economical high bandwidth solution at each cable user access point of copper, and also easily solve long distance requirements. The ruggedness of the LBH21 aluminum case and the high reliability of the design compliment the temperature-controlled packaging to provide an exceptional Ethernet product.

Example 1: In this application, where in expanding an industrial network environment, the new PLC units are deployed on an existing network and each needs one (or two for redundancy) Ethernet ports to carry status and control data to the control center the hardened version of LBH21 is typically used. The Fiber port on the converter switches is ideal for secure data communications over long distances that may be encountered in this edge of network application. Built with high-grade components, efficient cooling techniques and having no openings for dirt to enter, the LBH21-Series Converter Switches provide the very effective solution for this need.



Example 2: LBH21-Series "Drop & Add" capability

In this example, LBH21-Series Converter Switches form a gigabit backbone LAN with a "Drop & Add" capability that enables connecting many disparate devices in a fiber-media string, covering even very long distances (for example, a pipeline). Such designs are easily extended or expanded as conditions and devices needing network attachment change over time.

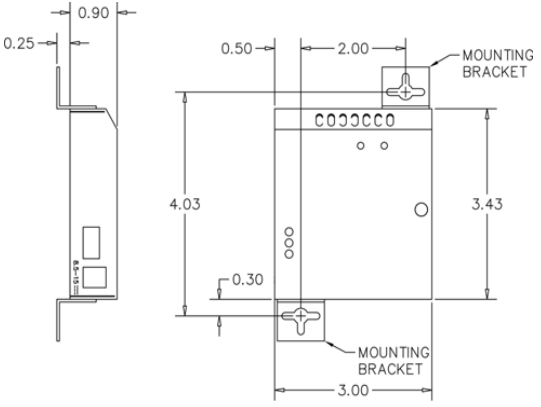


3. INSTALLATION

This section describes the installation of the LBH21-Series Converter Switches, including location, mountings, and power supply options and media connection.

3.1 Locating the Converter Switch Unit

All the LBH21-Series Switches operate in transparent half-and full-duplex mode. The store and forward switch easily takes care of network traffic and can be used as a useful, economical tool to expand an existing network.

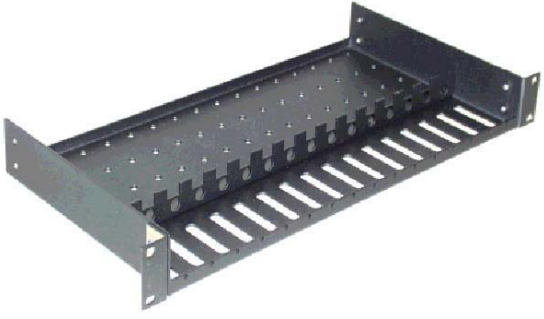


The compact and lightweight design of the LBH21-Series allows it to be easily installed in almost any location. A Velcro strip may be used for mounting the unit on a vertical surface such as a wall or cabinet, or for securing the unit on a table-top or shelf. Alternatively, metal mounting clips and screws are included for a rugged and secure mounting in any orientation.

Installation of the LBH21-Series Converter Switches is a simple procedure. The installation location is dependent upon the physical layout of the Ethernet network and associated cabling. Make sure the unit is installed in a location that is easily accessible to an AC power outlet or the appropriate DC source and where cooling is not inhibited. The green Power (PWR) LED must turn ON when power is applied.

3.2 LE1505-RACK for Rack mounting applications

For 19" rack-mounting of LBH21-Series Converter Switches, a rackmount tray is available, the LE1505-RACK. The Converter Switches are mounted with the DC power jack in the back, with the fiber and the RJ-45 connector in the front. Any mix of the Converter Switches and/or Media Converters may be placed on a tray, up to a maximum of 16 units. (The mounting spaces of the LBH21-Series are specific to the Black Box LBH10, LBH11 and LBH21-Series products and will not permit other models to be properly mounted).



In a typical installation, the LE1505-RACK, 19" rack-mount tray will hold a few (three to eight) LBH21-Series Converter Switches, with their power supplies plugged into power strips (not included) in the rear area of the tray. Metal mounting screws in the bottom-front hold the Converter Switches firmly in place. The beveled-top edge of the units permits the LEDs of each unit to be viewed for operational status, even when the units are very close together.

3.3 LH1505P-RACK for Rack Mounting

The LH1505P-RACK is another option for rack mounting the LBH21-Series Switches together in a 19" rack-mount tray. These models come with a built-in common universal AC power supply rated at 55 watts at 50°C ambient, 9 VDC regulated output, and supporting up to 16 Switches for LH1505P-RACK.

The side-view above is an example of an installation of the model LH1505P-RACK, 19" rack-mount tray, holding a few Switches, each with their power input plugged into the built-in common AC power supply in the rear area of the tray. (PS units that come with the MC's are not used).

Metal mounting screws in the bottom-front hold each of the media converters securing them in the tray and enabling separate removal for service. The dual LEDs permit viewing of Switch status from any angle.

Metal mounting screws in the bottom-front hold each of the media converters securing them in the tray and enabling separate removal for service. The dual LEDs permit viewing of Switch status from any angle.

3.4 DIN-Rail mounting option

The LBH21xA-HD and LBH21xA-PD Converter Switches, designed for use in “Factory Floor” Industrial Ethernet environments, are also available for DIN-Rail mounting in an enclosure having DIN Rails.

A LBH210A-P-SFP is shown alongside the DIN-Rail MC2 bracket

The metal DIN-Rail mounting hardware is optional and needs to be ordered as a separate item, e.g. Model #DIN-RAIL MC2. It comes with four screws to attach the bracket to the LBH21-Series switch.

3.5 Power Requirements for LBH21-Series Switches

LBH21-Series Switches are power-efficient and can work with an external AC power supply. LBH21-Series require a 12VDC input power supply.

The 12V DC power input has a plug of 2.5mm, center +ve , with 6 ft. cord. All the AC power supply info detail is provided in Technical Specifications Section 1.1.

LBH21-Series switches are designed to be used with UL listed Class II power supplies. The converter switches provide reliable operation, withstand higher temperature environments, and provide the DC power choices to the user to deploy in uncontrolled temperature environments.

The Direct DC (Internal) 12V DC (8 – 15V DC) has a built-in terminal block for +, -, ground. The 9V DC jack is also present. Detailed information about the 12 VDC, the 24V DC and the -48V DC is provided in the Technical Specifications Section 1.1.

Various models of DC power type and extended ambient temperature power supplies are available. Specify the power supply needed on your order.

Note: When connected to a -48 V centralized dc source these products are to be installed only in Restricted Access Areas (dedicated equipment rooms, electrical closets or the like).

3.6 Powering the LBH21-Series with DC power input

Each LBH21-Series is reliably equipped with an internal DC power supply, and has built-in screw terminals for secure attachment of the power leads. Three models support a range of power input types. The three model choices are for use with 12-VDC, 24-VDC or -48-VDC power. DC power input may be chosen for high-availability.

The extended temperature capability of the DC-powered LBH21-Sereis can go into temperature uncontrolled environments, rated at -40°C to +75°C. If indoors, the DC jack is also present and optionally can be used with an external AC power supply.

DC Power Terminals: “+”, “-”, gnd

GND: Terminal for “earth” or ground wire connection to the LBH21-Series case

Input Voltage: 8 - 15V DC (12V DC)
18 – 36V DC (24V DC)
36 – 60V DC (-48V DC)

Input current: 0.8 amp.(12V DC)
0.4 amp max.(24V DC)
0.2 amp max.(-48V DC)

Power Consumption: 4 watts typical, 5 watts max.

3.7 LBH21-Series, DC-powered Installation

This section describes the proper connection of the -48VDC leads (or 24VDC, 12VDC leads) to the DC power terminal block on the LBH21-Series media converter (as shown in Figure below)**.** The DC terminal block on the LBH21-Series is located on the left side of the unit and is equipped with three (3) screw-down lead posts. The power terminals are identified as positive (+) and negative (-), and they are floating inside the unit so that the user if desired may ground either of the terminals. The chassis is "earth" or ground (GND).

The connection procedure is straightforward. Simply insert the DC leads to the LBH21-Series power terminals, positive (+) and negative (-) screws. The use of Ground (GND) optional; it connects to the LBH21-Series case. Ensure that each lead is securely tightened from the top, as shown here.

NOTE: Always use a voltmeter to measure the voltage of the incoming power supply and figure out the +ve potential lead or -ve potential lead. The more +ve potential lead will connect to the post-labeled "+ve" and the rest to the "-ve".

The GND can be hooked up at the last.

When power is applied, the green PWR LED will illuminate.

3.8 Connecting Ethernet Media

The LBH21-Series Converter Switch can be connected to two media types i.e. fiber and copper (RJ-45) types, run at 1000BASE-T, 100BASE-TX, 10BASE-T and 1000BASE-SX/LX/ZX or 100BASE-FX. CAT 5E cables should be used when making 1000BASE-T connections. When the ports are used as 10BASE-T ports, CAT 3 may be used. In either case, the maximum distance for unshielded twisted pair cabling is 100 meters (328 ft). For fiber port 100BASE-FX or 1000BASE-SX multi-mode, 50/125 or 62.5/125 microns cabling can be used, whereas for single-mode, 9/125 microns cabling should be used. Fiber cabling supports much longer cable distance and higher bandwidths as compared to copper wiring.

Media	IEEE Standard	Connector
Twisted Pair (CAT 3 or 5)	10BASE-T	RJ-45
Twisted Pair (CAT 5)	100BASE-TX	RJ-45
Twisted pair (CAT5E or CAT6)	1000BASE-T	RJ-45
Fiber (Multimode, Single-mode)	100BASE-FX	LC (SFP)
Fiber (Single-mode)	1000BASE-SX/LX/ZX	LC (SFP)

NOTE : *It is recommended that high quality CAT 5E or CAT 6 cables (which work for 10Mbps, 100Mbps and 1000Mbps) be used whenever possible in order to provide flexibility in a mixed-speed network, since LBH21-Series switch ports are auto-sensing for either 10-,100- or 1000-Mbps. Note that the auto-cross function does not operate, if the port is fixed or not supporting auto-negotiation.*

3.8.1 Connecting Twisted Pair

The following procedure describes how to connect a 10BASE-T, 100BASE-TX or 1000BASE-T twisted pair segment to the RJ-45 port. The procedure is the same for both unshielded and shielded twisted pair cables.

1. Using standard twisted pair media, insert either end of the cable with a RJ-45 plug into the RJ-45 connector of the port. Note that, even though the connector is shielded, either unshielded or shielded cables and wiring may be used.
2. Connect the other end of the cable to the corresponding device.
3. Use the LINK LED to ensure proper connectivity by noting that the LED will be illuminated when the unit is powered and proper connection is established. If this does not help, ensure that the cable is connected properly and that the device on the other end is powered and is not defective.
4. For Port # 1 or 1SW, if the LINK LED is not illuminated, move the switch, which has a cross-over or up-link for linking to another hub or Switch.

3.8.2 Installing LC-type SFP module, "Small Form Pluggable (SFP)"

Grasp the SFP module by your thumb and forefinger. Insert the SFP into the SFP slot. Apply a light pressure to the SFP until the device clicks and locks into position. Now connect your LC connectors.

3.8.3 Connecting Single-Mode Fiber Optic

When using single-mode fiber cable, be sure to use single-mode fiber port connectors. Single-mode fiber cable has a smaller diameter than multi-mode fiber cable (9/125 microns for single-mode, 50/125 or 62.5/125 microns for multi-mode where xx/xx are the diameters of the core and the core plus the cladding respectively). Single-mode fiber allows full bandwidth at longer distances, about 70km with the single-mode LC.

The same procedures as for single-mode fiber apply to multi-mode fiber connectors.

3.8.4 Power Budget Calculations, Fiber Media

Receiver Sensitivity and Transmitter Power are the parameters necessary to compute the power budget. To calculate the power budget of different fiber media installations using Black Box products, the following equations should be used:

OPB (Optical Power Budget) = P_T(min) - P_R(min)

where P_T = Transmitter Output Power, and P_R = Receiver Sensitivity

Worst case OPB = OPB - 1dB(for LED aging) - 1dB(for insertion loss)

Worst case distance = {Worst case OPB, in dB} / [Cable Loss, in dB/Km]

where the “Cable Loss” for 62.5/125 and 50/125μm (Multi-mode) is 2.8dB/km,

and the “Cable Loss” for 100/140 (Multi-mode) is 3.3 dB/km,

and the “Cable Loss” for 9/125 (Single-mode) is 0.5 dB/km

The following data has been collected from component manufacturer’s (HP’s, and Siemens’) web sites and catalogs to provide guidance to network designers and installers.

		SFP Model				
		LFP220P	**LFP222P**	**LFP223P**	**LFP224P**	**LFP225P**
Speed / Std.		1000Mb / SX	1000Mb / LX	1000Mb / LX	1000Mb / ZX	1000Mb / ZX
Mode		Multi-mode	Single-mode	Single-mode	Single-mode	Single-mode
Std. km	**fdx (hdx)**	0.55	10	25	40	70
Wavelength	**nm**	850	1310	1310	1550	1550
Cable	**Size µm**	62.5/125 | 50/125	9/125	9/125	9/125	9/125
X'mitr Output	**$P_{T,}$ dB**	-9.5	-10	-3	-5	-2
R'cvr Sens.	**$P_{R,}$ dB**	-17	-22	-21	-22	-22
Worst	**OPB, dB**	5.5	10	16	15	18
Worst* distance	**Km, fdx**	2	22	40	60	90
typical	**OPB, dB**	10.5	11	18	17	20
typical* Distance	**Km, fdx**	4	24	45	68	100

**** Note: The use of either multi-mode or single-mode fiber to operate at 1000Mbps speed over long distances (i.e., over approx. 400 meters) can be achieved only if the following factors are both applied:***

- *The 1000Mb fiber segment must operate in full-duplex (FDX) mode, and*
- *The worst-case OPB of the fiber link must be greater than the fiber cable's passive Attenuation.*

(Attenuation = Cable loss+LED aging loss+Insertion loss+safety factor)

3.8.5 Connections to NICs which support Auto-Negotiation

The copper ports of the LBH21-Series Converter Switches will function properly with NICs (Network Interface Cards) which support Auto-Negotiation, and the Fast Link Pulse (FLP) coding for the 1000BASE-T signaling system. When connecting a NIC to the LBH21-Series, it may be necessary to reload the NIC drivers on the user device if the NIC has been communicating with a protocol other than 1000BASE-T (such as 100BASE-TX). When 1000Mb operation is agreed and in use, the Gb LED is illuminated steady ON and is OFF, for 10- or 100-Mbps traffic.

4. OPERATION

4.1 Triple-Speed Functionality, and Switching

The LBH21-Series Converter Switches provide three switched ports. The architecture supports a triple speed-switching environment, with standard auto-negotiation capability.

The switched RJ-45 ports are full- or half-duplex auto-sensing for mode and speed, and auto cross for plug polarity. (See Section 2.2). When the connected device is 10 Mbps, the LBH21-Series switch obeys all the rules of 10-Mbps Ethernet configurations. The 10 Mbps users can "communicate" with 100-Mbps users as well as other 10 Mbps users through the switch. Similarly, the 100-Mbps traffic obeys the rules of 100Mbps Ethernet, and can communicate with 10 Mb and 100 Mb users.

LBH21-Series units are plug-and-play devices. There is no software configuring to be done at installation or for maintenance. The only hardware configuration settings are user options for port #2, to configure it FF/AN. The internal functions of both are described below.

Switching, Filtering and Forwarding

Each time a packet arrives on one of the switched ports, the decision is taken to either filter or to forward the packet. Packets whose source and destination addresses lie on the same port segment, will be filtered, constraining them to one port and relieving the rest of the network from processing them. A packet whose destination address is on another port segment will be forwarded to the appropriate port, and will not be sent to the other ports where it is not needed. Packets needed for maintaining the operation of the network (such as occasional multi-cast packets) are forwarded to all ports. The LBH21-Series Converter Switches operate in the store-and-forward switching mode, which eliminates bad packets and enables peak performance to be achieved when there is heavy traffic on the network.

Switching, Address Learning

The LBH21-Series units have address table capacity of 1K node addresses, and are suitable for use in large networks. They are self-learning, so that as nodes are added or removed or moved from one segment to another, the LBH21-Series switch automatically keeps up with node locations.

An address-aging algorithm causes least-used addresses to fall out in favor of new frequently used addresses. To reset the address buffer, cycle power down-and-up.

4.2 Auto-cross (MDI-X), Auto-negotiation and Speed-sensing

The RJ-45 ports support auto cross (MDI or MDI-X) in the auto-negotiation mode according to the IEEE 802.3z standard. No crossover cables are needed when connecting the LBH21-Series to other unmanaged switches, legacy hubs, managed switches, media-converters etc. Please note that there can be conditions with managed switches where the switch manager fixes the port settings via software, and the result of the auto-negotiation is changed in the managed switch by the manager commands. In such cases, the 10/100/1000 speed or the F/H mode may be affected, but auto-cross in the LBH21 Switches will still work. The auto cross function cannot be disabled.

When an RJ-45 cable connection is made, and each time LINK is enabled, auto-negotiation takes place (except for legacy products, which do not have auto-negotiation and which go to the default state accordingly). The LBH21-Series Switch advertises its capability for 10, 100 or 1000Mbps speed and F/H duplex mode, and the device at the other end of the cable should similarly advertise / respond. Both sides will agree to the speed and mode to be used per the IEEE 802.3z standard. Depending upon the devices connected,

this will result in agreement to operate at 10Mbps, 100Mbps or 1000Mbps speed, and full- or half-duplex mode.

4.3 Dual LEDs, Top-front and in End with ports

LED	Description
PWR	Illuminates GREEN to indicate power applied.
LK/ ACT	Steady ON for LINK w/no traffic, blinking for activity per port. LINK will turn off in the event connectivity is lost between the ends of the twisted pair segment or a loss of power occurs in the unit or remote device. The Link ports are also represented by LA1, LA2, and LA3. (Steady On or steady Off indicates no Receive Activity).
Gb	Steady ON for 1000Mb speed, OFF for 100Mb or 10Mb speed per port.

5. TROUBLESHOOTING

All Black Box Ethernet products are designed to provide reliability and consistently high performance in all network environments. The installation of Black Box LBH21-Series Switch is a straightforward procedure (see INSTALLATION, Section 3.0); the operation is also straight forward and is discussed in Section 4.

Should problems develop during installation or operation, this section is intended to help locate, identify and correct these types of problems. Please follow the suggestions listed below prior to contacting your supplier. However, if you are unsure of the procedures described in this section or if the LBH21-Series Switch is not performing as expected, do not attempt to repair the unit; instead contact your supplier for assistance or contact Black Box Customer Support.

5.1 Before Calling for Assistance

1. If difficulty is encountered when installing or operating the unit, refer back to the Installation Section of the applicable chapter of this manual. Also check to make sure that the various components of the network are interoperable.
2. Check the cables and connectors to ensure that they have been properly connected and the cables/wires have not been crimped or in some way impaired during installation. (About 90% of network downtime can be attributed to wiring and connector problems.)
3. If the problem is isolated to a network device other than the LBH21-Series Switch product, it is recommended that the problem device is replaced with a known good device. Verify whether or not the problem is corrected. If not, go to Step 4 below. If the problem is corrected, the LBH21-Series Switch and its associated cables are functioning properly.
4. If the problem continues after completing Step 3 above, contact your supplier of the LBH21-Series Switch unit or if unknown, contact Black Box Tech support (see page 6 of this guide) for assistance.

5.2 When Calling for Assistance

Please be prepared to provide the following information.

1. A complete description of the problem, including the following points:
   a. The nature and duration of the problem;
   b. Situations when the problem occurs;
   c. The components involved in the problem;
   d. Any particular application that, when used, appears to create the problem;
2. An accurate list of Black Box product model(s) involved, with serial number(s). Include the date(s) that you purchased the products from your supplier.
3. It is useful to include other network equipment models and related hardware, including personal computers, workstations, terminals and printers; plus, the various network media types being used.
4. A record of changes that have been made to your network configuration prior to the occurrence of the problem. Any changes to system administration procedures should all be noted in this record.

5.3 Return Material Authorization (RMA) Procedure

All returns for repair must be accompanied by a Return Material Authorization (RMA) number. To obtain an RMA number, please contact Black Box Tech support.

Please have the following information readily available:

Name and phone number of your contact person.
Name of your company / institution
Your shipping address
Product name
Serial Number (or Invoice Number)
Packing List Number (or Sales Order Number)
Date of installation
Failure symptoms, including a full description of the problem.

Black Box will carefully test and evaluate all returned products, will repair products that are under warranty at no charge, and will return the warranty-repaired units to the sender with shipping charges prepaid (see Warranty Information, Appendix A, for complete details). However, if the problem or condition causing the return cannot be duplicated by Black Box, the unit will be returned as:

No Problem found.

Black Box reserves the right to charge for the testing of non-defective units under warranty. Testing and repair of product that is not under warranty will result in a customer (user) charge.

5.4 Shipping and Packaging Information

Should you need to ship the unit back to Black Box, please follow these instructions:

1. Package the unit carefully. It is recommended that you use the original container if available. Units should be wrapped in a "bubble-wrap" plastic sheet or bag for shipping protection. (You may retain all connectors and this Installation Guide.)

CAUTION: Do not pack the unit in Styrofoam "popcorn" type packing material. This material may cause electro-static shock damage to the unit.

2. Clearly mark the Return Material Authorization (RMA) number on the outside of the shipping container.
3. Black Box is not responsible for your return shipping charges.
4. Ship the package to:

   Black Box Network Services
   (contact Black Box Tech support for information)

APPENDIX A: WARRANTY INFORMATION

Black Box warrants its products to be free from defects in materials and workmanship for a period of three (3) years from the date of shipment.

During this warranty period, Black Box will repair or, at its option, replace components in the products that prove to be defective at no charge other than shipping and handling, provided that the product is returned pre-paid to Black Box.

This warranty will not be effective if, in the opinion of Black Box, the product has been damaged by misuse, misapplication, or as a result of service or modification other than by Black Box.
Black Box reserves the right to make a charge for handling and inspecting any product returned for warranty repair which turns out not to be faulty.